植物研究雑誌
J. Jpn. Bot.
75: 303–307 (2000)

Usnea fragilescens Lynge (Parmeliaceae, lichenized Ascomycetes), New to Japan

Yoshihito OHMURA[a], Kwang-Hee MOON[b] and Hiroyuki KASHIWADANI[c]

[a]Center for the Study of International Cooperation in Education, Hiroshima University, Kagamiyama, 1–5–1 Higashi-Hiroshima, Hiroshima, 739–8529 JAPAN;
[b]The Research Institute for Natural Sciences, Sookmyung Women's University, Seoul, 140–742 KOREA;
[c]Department of Botany, National Science Museum, Amakubo, 4–1–1 Tsukuba, Ibaraki, 305–0005 JAPAN

(Received on May 22, 2000)

Usnea fragilescens Lynge is reported as new to the lichen flora of Japan. It is known only from southeast Hokkaido in northern Japan. Japanese specimens contain barbatic, 4-O-demethylbarbatic, and protocetraric acids as major lichen substances. This chemical strain is newly reported for this taxon.

Key words: chemical strain, Japan, lichenized ascomycetes, *Usnea*, *Usnea fragilescens*

Usnea fragilescens Lynge belongs to sect. Barbatae Motyka subsect. Comosae Motyka. It is easily distinguished from related species by inflated thallus, jet black base, and slightly excavated soralia with granular soredia. When Clerc (1987) revised Scandinavian material of the *U. fragilescens* aggregate, he recognized two varieties based on habitat differences. According to Clerc (1987), *U. fragilescens* var. *fragilescens* is mainly saxicolous, with sparsely branched thalli which are thinner and fusiform at the base. While *U. fragilescens* var. *mollis* (Vain.) Clerc is generally corticolous, with richly branched thalli which are thicker at the base.

During the study of Japanese specimens of *Usnea*, some specimens collected from southeast Hokkaido were identified as *U. fragilescens*, a taxon which had not been previously reported for Japan. The purpose of this paper is to discuss the morphological, chemical, and ecological features of this species.

Materials and Methods

This study is based on herbarium specimens from the National Science Museum, Tokyo (TNS). Type specimens of related taxa preserved in BG and BM were also studied.

Morphological observations were made using a dissecting microscope. The diameter of branches and thickness of the cortex, medulla, and axis were measured using well developed thicker branches at 50 magnifications. The ratio of the thickness of the cortex, medulla, and axis is reported following the methods of Clerc (1984).

Lichen substances were studied using thin layer chromatography (TLC) (Culberson and Johnson 1982). Solvent B system (hexane: methyl *tert.*-butyl ether: formic acid = 140 : 72 : 18) was used for all TLC analyses.

Description based on Japanese material is given.

Results and Discussion

Usnea fragilescens Lynge in Vid. Selsk.

Skr. I. M.-N. Kl. **7**: 230 (1921).

Lectotype (selected by Clerc 1987): Norvegia occidentalis, Inter Manger i Hallandsvand insulae Radoen, rupicola, August 15, 1909, Havaas (O, not seen; isolectotype in BG!). Chemistry: norstictic, cryptostictic, stictic, and menegazziaic acids (Clerc 1987).

Usnea mollis Stirt. in Scot. Nat. **6**: 109 (1881), nom. illeg., non Baumg. (1790) –*U. florida* var. *mollis* Vain. in Etud. Lich. Brésil **1**: 4 (1890) –*U. malacea* Zahlbr. in Cat. Lich. Univ. **6**: 588 (1930), nom. illeg., non *U. malacea* (Stirt.) Zahlbr. (1930) –*U. fragilescens* var. *mollis* (Vain.) Clerc in Nord. J. Bot. **7**: 492 (1987), syn. nov.

Lectotype (selected by Clerc 1987): Scotland, New Galloway, Mc Andrew (BM!). Chemistry: stictic, constictic, and cryptostictic acids (Clerc 1987).

Thallus fruticose, erect to subpendent, up to 6.5 cm long, grayish green when fresh, straw yellow in herbarium specimens, jet black at base; branching anisotomic-dichotomous; branches slightly glossy on surface, lacking pseudocyphella and macula, terete, inflated, gradually tapering, with sparse fibrils and lateral branches especially towards the apices, 0.8–1.2 mm in diameter; lateral branches constricted at base; papillae common, verrucose; soralia common, formed mainly on lateral and terminal branches, developed from top of eroded papillae, more or less discrete, rounded, becoming as large as the branch diameter, slightly stipitate, cortical margin not reflexed, slightly concave at top with granular soredia and rarely with isidiomorphs. **Cortex** thin, 3.4–6.4 % of the radius, lacking red pigment. **Medulla** lax, wide, 29–38 % of the radius, lacking red pigment. **Axis** solid, thin, 17–28 % of the diameter. **Apothecia** not seen.

Chemistry. Usnic, barbatic, 4-O-demethylbarbatic, protocetraric, salazinic acids (trace), and unidentified substances (UF) [R*f* of UF*n*/ R*f* of norstictic acid, R*f* of atranorin = UF_1, 45/35, 74 (Rf class 5, brown after heating, sprayed with H_2SO_4); UF_2, 28/35, 74 (Rf class 3-4, pale brown after heating, sprayed with H_2SO_4)].

Usnea fragilescens is characterized by the following morphology: 1) erect to subpendent thallus with anisotomic-dichotomous branching (Fig. 1A), 2) jet black base (Fig. 1B), 3) inflated branches which are constricted at base, 4) slightly excavated, rounded soralia with granular soredia, which become as large as the branch diameter (Fig. 1C), and 5) non-reflexed cortical margin around soralia (Fig. 1C). These features are identical to those of the type specimen of *U. fragilescens.* In addition, the ratios of the cortex, medulla, and axis of the Japanese specimens fit within the natural range for this species (Table 1).

The major chemical substances of all Japanese specimens included barbatic, 4'-O-demethylbarbatic, and protocetraric acids. In addition, small amounts of salazinic acid and various unidentified substances were also detected. These substances were consistently detected in all specimens, with some variation in concentration. Although six chemical strains have been reported for the species including 1) usnic, norstictic, cryptostictic, stictic, ± constictic, ± menegazziaic, and ± fatty acids, 2) usnic, ± cryptostictic, stictic, and ± menegazziaic acids, 3) usnic, salazinic acids, ± stictic acid aggregate, and ± atranorin, 4) usnic, psoromic, and ± 2'-O-demethylpsoromic acids, 5) usnic and squamatic acids, and 6) usnic acid only, the chemical strain from Japan has not been reported for either Europe or North America (Clerc 1987, Halonen et al. 1998). Chemical differences suggest that the Japanese population is geographically isolated from the other strains. However, no morphological differences between Japanese specimens and those collected from other regions are reported. Therefore, Japanese specimens simply repre-

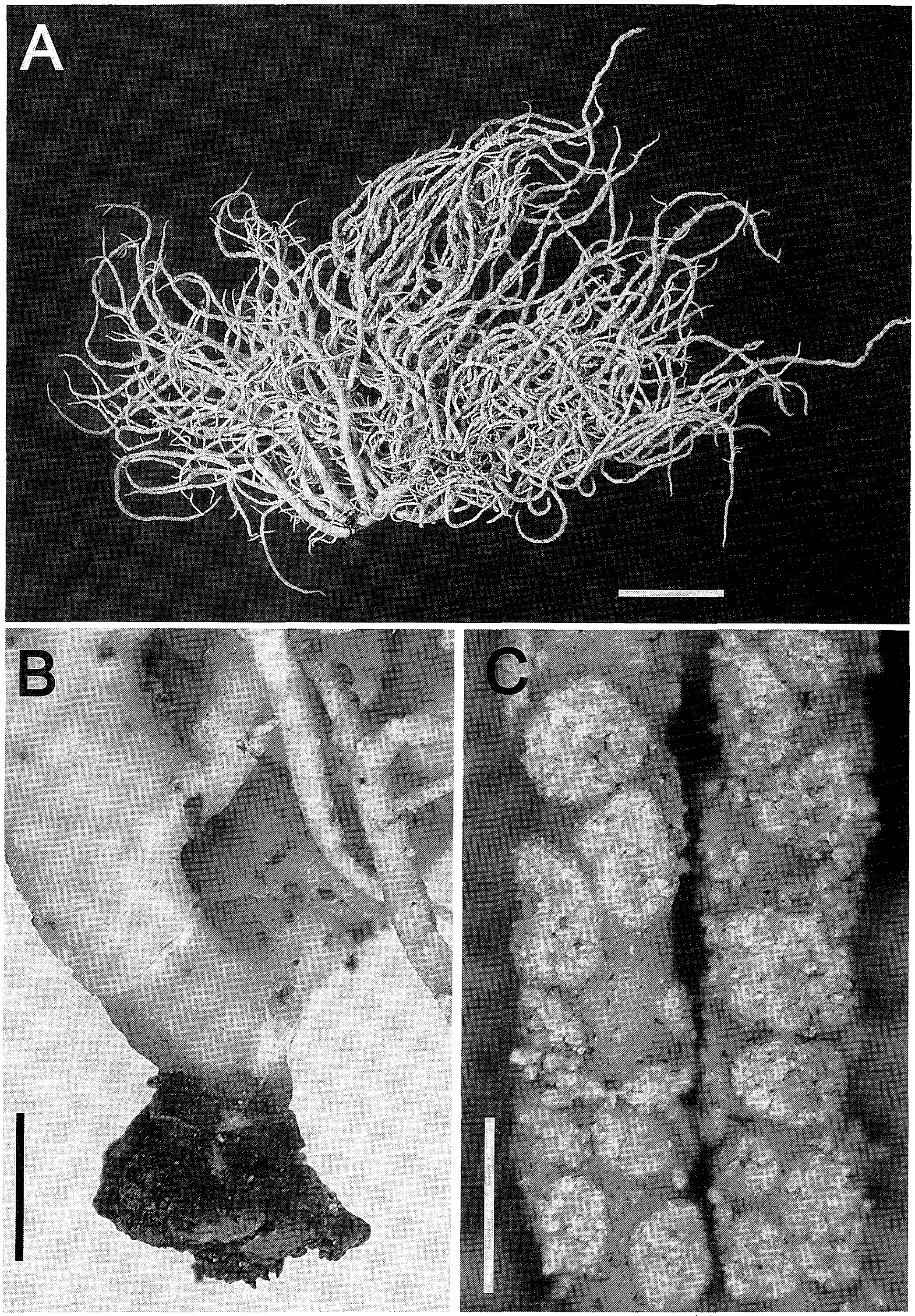

Fig. 1. Diagnostic features of *Usnea fragilescens*. A. Subpendent thallus with anisotomic-dichotomous branching (K. H. Moon 4484). B. Jet black base (S. Arakawa 1694). C. Slightly excavated soralia with granular soredia, which are rounded in shape, becoming as large as the branch diameter, with non–reflexed cortical margins around soralia (K. H. Moon 4484). Scales: A = 1 cm; B = 1 mm; C = 0.5 mm.

Table 1. Comparison of ratios based on the thickness of the cortex, medulla, and axis in *Usnea fragilescens*. Mean and extreme values (in the parenthesis) are shown, n = total number of samples examined

Specimen	Country	Cortex (% of radius)	Medulla (% of radius)	Axis (% of diameter)	Diameter of branch (mm)	n
Specimens collected from Japan	Japan	(3.4)–5.1–(6.4)	(29)–33–(38)	(17)–23–(28)	(0.8)–1.0–(1.2)	6
Brodo, Lich. Can. Exs. 71&215	Canada	(6.6)–7.2–(7.7)	(31)–33–(34)	(19)–21–(23)	(1.0)–1.2–(1.4)	2
Vězda, Lich. Sel. Exs. 571	Ireland	8.3	31	22	1.1	1
Havaas, Lich. Norveg. Occid. Exs. 102	Norway	(7.8)–8.1–(8.3)	(33)–33–(33)	(18)–18–(18)	(0.9)–1.1–(1.3)	2
Specimens collected from Norway reported as *U. fragilescens* var. *fragilescens* (by Clerc 1987)	Norway	(3.0)–4.6–(9.0)	(24)–35–(40)	(13)–21–(35)	–	63
Specimens collected from Norway reported as *U. fragilescens* var. *mollis* (by Clerc 1987)	Norway	(3.5)–5.4–(8.5)	(26)–32–(39)	(14)–25–(40)	–	25
Lectotype of *U. fragile scens* Lynge (by Clerc 1987)	Norway	3.5	36	21	–	1
Lectotype of *U. mollis* Stirt. (non Baumg.) (by Clerc 1987)	Scotland	4.5	33.5	24	–	1

sent a new chemical strain of *U. fragilescens*.

According to Clerc (1987), *U. fragilescens* grows on both rocks and tree bark in Europe. Saxicolous specimens tend to have thinner and fusiform bases, with sparsely branched thalli, while corticolous specimens tend to have thicker bases, with richly branched thalli. These differences fall within the natural morphological variation for this species, and do not deserve taxonomic distinction.

The inflated branches and excavated soralia with granular soredia typical of *U. fragilescens* resembles somewhat similar features in *U. glabrata* (Ach.) Vain. However, *U. fragilescens* can be distinguished from *U. glabrata* by its jet black base. In addition, the soralia of *U. fragilescens* are slightly concave at the top with non-reflexed cortical margins, while the soralia of *U. glabrata* are deeply excavated with distinctly reflexed cortical margins. The jet black base and excavated soralia with granular soredia of *U. fragilescens* also resembles similar features in *U. fulvoreagens* (Räsänen) Räsänen, *U. glabrescens* (Nyl.) Vain., and *U. wasmuthii* Räsänen. But *U. fragilescens* can be distinguished from these taxa on the basis of its inflated branches which are constricted at the base and slightly glossy branch surfaces.

In Japan, *U. fragilescens* has only been collected from Akkeshi, in southeast Hokkaido, where it occurs on the bark of *Abies sachalinensis* and *Picea glehnii* at elevations between 20 and 75 m. No saxicolous material has been found. Akkeshi is located in a highly humid maritime area, one of the foggiest areas in Japan. This species has been also collected from similar habitats in western Europe and British Columbia (Clerc 1987, Halonen et al. 1998).

Exsiccata examined. Brodo, Lich. Can. Exs. 71, 215; Havaas, Lich. Norveg. Occid. Exs. 102; Vězda, Lich. Sel. Exs. 571.

Specimens examined. **JAPAN**. **Hokkaido**. Prov. Kushiro: ca. 1.5 km east of Rokubansawa, Hamanaka-cho, Akkeshi-gun (43°04′N, 140°04′E), on bark of *Picea glehnii*, elevation about 40 m, July 9, 1997. S. Arakawa 1693, 1694; Hillside facing Kiritappu Marsh, Hamanaka-cho, Akkeshi-gun (43°04′N, 145°02′E), on bark of *Abies sachalinensis*, elevation 20 to 40 m, September 2, 1999, K. H. Moon 4217; same locality (43°04′N, 145°03′E), September 2, 1999, K. H. Moon 4389; Fukushima, Biwase-mura, Hamanaka-cho, Akkeshi-gun (43°06′N, 145°00′E), on decayed wood of *Abies sachalinensis*, elevation about 75 m, September 1, 1999, K. H. Moon 4136; ca. 6 km from Chiripu-mura to Akkeshi-cho, Akkeshi-gun (43°01′N, 145°02′E), on bark of *Abies sachalinensis*, elevation about 70 m, September 3, 1999, K. H. Moon 4484.

We wish to express gratitude to Dr. L. St. Clair of Brigham Young University, for critical reading and linguistic revision of this manuscript. Y. Ohmura indebted to the curators of BG and BM for permission to review type specimens. K. H. Moon received financial support for her field study of Kiritappu Marsh from the Kiritapp Mire Research Center.

References

Clerc P. 1984. Contribution à la revision de la systém atique des usnées (Ascomycotina, *Usnea*) d'Europe. I.–*Usnea florida* (L.) Wigg. emend. Clerc. Crypt. Bryol. et Lichénol. **5**: 333–360.

——1987. Systematics of the *Usnea fragilescens* aggregate, and its distribution in Scandinavia. Nord. J. Bot. **7**: 479–495.

Culberson C. F. and Johnson A. 1982. Substitution of methyl tert.-butyl ether for diethyl ether in the standardized thin-layer chromatographic method for lichen products. J. Chromatography **238**: 483–487.

Halonen P., Clerc P., Goward T., Brodo I. M. and Wulf K. 1998. Synopsis of the genus *Usnea* (lichenized Ascomycetes) in British Columbia, Canada. Bryologist **101**: 36–60.

大村嘉人[a]，文　光喜[b]，柏谷博之[c]：日本新産種の *Usnea fragilescens* Lynge（ウメノキゴケ科，地衣類）

ウメノキゴケ科サルオガセ属地衣類の *Usnea fragilescens*（アッケシサルオガセ 新称）が北海道霧多布湿原周辺で発見された．本種は西ヨーロッパおよび北米から報告されているが，これまで日本からの報告はなかった．本種の特徴は次の通りである．地衣体は直立–半懸垂性，不同長二叉分岐，地衣体基部は黒炭色，分枝の髄層は厚く軸が細いため膨らんだようになる（%C/%M/%A = 5.1/33/23）．枝の幅ほどの円形の粉芽塊を持ち，その表面はやや凹み，顆粒状の粉芽を生じる．粉芽塊の縁の皮層は反り返らない．今回採集された全ての標本は，バルバチン酸，4-O-デメチルバルバチン酸，プロトセトラール酸を主成分として含む．この化学変異株は本種では初めての報告である．

（[a]広島大学教育開発国際協力研究センター，
[b]淑明女子大学自然科学研究所，
[c]国立科学博物館植物研究部）